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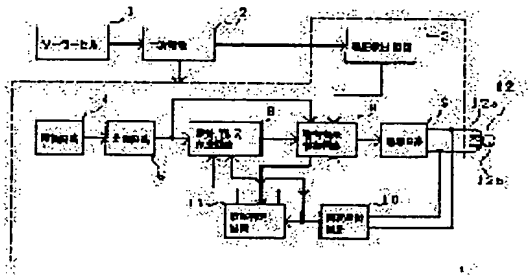
(54) ELECTRONIC CLOCK

(57)Abstract:
PROBLEM TO BE SOLVED: To cancel an alarm display state more appropriately by considering the driving condition of a stepping motor where the stepping motor is driven for a fixed amount of time by a normal drive pulse with a certain capacity as well as the voltage of a secondary battery, and canceling the alarm display state.
SOLUTION: An oscillation circuit 4 outputs a signal with, for example, 32,768 Hz due to the vibration of a crystal vibrator. A dividing circuit 5 divides the signal and outputs it to a needle-handling pulse creation circuit 6 and an alarm display control circuit 8. The creation circuit 6 creates a normal drive pulse and a correction drive pulse and outputs them to the control circuit 8. A voltage detection circuit 3 detects whether the voltage of a secondary battery 2 is equal to or less than 1.2 V or exceeds 1.3 V and outputs the obtained information to the control circuit 8. A normal drive pulse is amplified by a drive circuit 9, is outputted to a coil 12a of a stepping motor 12, and rotates a coil 12b. A detection circuit 3 judges that voltage of the battery 2 is equal to or less than 1.2 V and transfers the result to the control circuit 8, and the circuit 8 performs output with an interval that differs from each 1 second for the interval of the handling of the needle of the drive pulse, and displays a warning by 2-second handling of the needle.



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APPLICANT(S)	CITIZEN WATCH CO LTD
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[Claims]

[Claim 1] A generation-of-electrical-energy means, an accumulation-of-electricity means to conserve the power generated with this generation-of-electrical-energy means, and an electrical-potential-difference detection means to detect the electrical potential difference of this accumulation-of-electricity means, A rotor, a coil, the step motor that consists of a stator, and a rotation detection means to detect rotation of said rotor, and nonrotation, A driving pulse creation means to create two or more driving pulses for driving said step motor, In the electronic clock which has a mode shift means to shift to the second mode from the first mode when said electrical-potential-difference detection means had the electrical potential difference of said accumulation-of-electricity means lower than the predetermined electrical potential difference and it detects The electronic clock characterized by having a mode return means to shift to the first mode from the second mode using the information on a drive judging means to judge that said rotor has been driven by a certain driving pulse during a fixed period, and said electrical-potential-difference detection means and said drive judging means.

[Claim 2] Said drive judging means is an electronic clock according to claim 1 characterized by judging with it having driven when a fixed period drive was carried out by the driving pulse below the driving pulse of predetermined magnitude among two or more driving pulses which said driving pulse creation means creates.

[Claim 3] Said drive judging means is an electronic clock according to claim 1 or 2 characterized by controlling to change the driving pulse which said driving pulse creation means outputs when it judges with it having driven when a fixed period drive was carried out by a certain driving pulse among two or more driving pulses which said driving pulse creation means creates to a smaller driving pulse.

[Claim 4] An alarm display [in / said first mode is a normal state, and said second mode is in an alarm display condition, and / this alarm display condition] is an electronic clock according to claim 1 to 3 characterized by being the display by the irregular movement drive of a guide.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the mode shift by electrical-potential-difference change of the electronic clock which has an accumulation-of-electricity means.

[0002]
[Description of the Prior Art] Conventionally, when the alarm display of the sag of an electronic clock which has the accumulation-of-electricity means in which charges and discharges, such as a rechargeable battery, are possible became less than [regularity electrical-potential-difference 1.2V], it was performing the alarm display of performing movement for 2 seconds etc. However, charge is performed to a rechargeable battery, when the electrical potential difference of a rechargeable battery rises and it becomes more than 1.2V, shortly after making the hand usually move immediately, when it becomes less than [1.2V], it becomes movement for 2 seconds again, and there is a problem of being troublesome on use. Therefore, when it is usually that the hand is moved, in order to maintain fixed period usual movement, approaches, such as JP,7-46157,B and JP,9-90064,A, are proposed.
[0003] The example which JP,7-46157,B gives the hysteresis by the electrical potential difference is introduced. If the electronic clock by this conventional method will shift to the alarm display condition of warning of charge from a normal state if it has two detection electrical potential differences and the electrical potential difference of a rechargeable battery becomes less than [1.2V], and it becomes more than [an electrical potential difference is an electrical potential difference higher than 1.2V] 1.3V, it will shift to a normal state from an alarm display condition. The example in this case is explained based on a drawing. Drawing 6 is the transition diagram of the condition of an electrical potential difference and an electronic clock in the conventional electronic clock. An axis of ordinate is the electrical potential difference of a rechargeable battery, and an axis of abscissa is time amount. It begins and the electrical potential difference of a rechargeable battery has become those or more [1.2] with V, and a normal state. However, if an electrical potential difference falls in 1.2V at time of day t1, it will be in an alarm display condition. And since it does not shift to a normal state unless it becomes more than 1.3V, even if an electrical potential difference is set to 1.2V at time of day t2, it is still an alarm display condition. And although it once becomes the peak of an electrical potential difference at time of day t3, since it is less than [1.3V], it cannot escape from an alarm display condition. Furthermore, if time amount passes and time of day t4 comes, an electrical potential difference will be set to 1.3V, and an electronic clock will shift to a normal state from an alarm display condition.
[0004] Moreover, in JP,9-90064,A, the example which gives the hysteresis by time amount is introduced. The electronic clock of the conventional example here will shift to an alarm display condition from a normal state, if it has one detection electrical potential difference and the electrical potential difference of a rechargeable battery becomes below about 1.2V, but even if an electrical potential difference becomes more than 1.2V, it does not shift to a normal state from an alarm display condition immediately, but when only a fixed period T is more than 1.2V, it shifts to a normal state. The example in this case is explained based on a drawing. Drawing 7 is the transition diagram of the condition of an electrical potential difference and an electronic clock in this electronic clock. An axis of ordinate is the electrical potential difference of a rechargeable battery, and an axis of abscissa is time amount. It begins and the electrical potential difference of a rechargeable battery has become a normal state with V or more [1.2]. However, if an electrical potential difference falls in 1.2V at time of day t6, it will be in an alarm display condition. Although an electrical potential difference is set to 1.2V at time of day t7, since only a fixed period T has not passed, it is still an alarm display condition. And an electrical potential difference cannot become less than [1.2V] again at the time of day t8 shorter than a fixed period T which passed T1, and it cannot escape from an alarm display condition. And since an electrical potential difference becomes more than 1.2V again and more than 1.2V is continued between fixed time amount T till time of day t10 if time of day t9 comes, an electronic clock shifts to a normal state from an alarm display condition.
[0005]
[Problem(s) to be Solved by the Invention] However, by the above-mentioned approach, it cannot say that the property of the step motor of a rechargeable battery or an electronic clock is fully taken into consideration, but there is a problem. For example, it is known that a rechargeable battery has a thing with a polarization operation. This is a phenomenon which an apparent

electrical potential difference goes up, in spite of fully not charging the rechargeable battery, if it charges quickly. In the hysteresis by the electrical potential difference, when it shifts to a normal state with the electrical potential difference of this appearance, a polarization operation is settled and an electrical potential difference falls, there is a problem of being in an alarm display condition immediately.

[0006] Moreover, in neither the hysteresis of an electrical potential difference, nor the hysteresis of time amount, it is completely taken into consideration about the load of a step motor called the time of low temperature and calender delivery. It is necessary to set up highly the detection electrical potential difference which shifts to a normal state beforehand in consideration of the case where the load of a step motor is heavy. However, if a detection electrical potential difference is highly set up in consideration of a load, the problem of being hard coming to shift at a normal state at the time of no-load will arise. The purpose of this invention solves the above-mentioned problem, and is to propose the electronic clock which can shift to a normal state from an alarm display condition more certainly.

[0007]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention is carrying out the following configurations. Namely, a generation-of-electrical-energy means, an accumulation-of-electricity means to conserve the power generated with this generation-of-electrical-energy means, and an electrical-potential-difference detection means to detect the electrical potential difference of this accumulation-of-electricity means, A rotor, a coil, the step motor that consists of a stator, and a rotation detection means to detect rotation of said rotor, and nonrotation, A driving pulse creation means to create two or more driving pulses for driving said step motor, In the electronic clock which has a mode shift means to shift to the second mode from the first mode when said electrical-potential-difference detection means had the electrical potential difference of said accumulation-of-electricity means lower than the predetermined electrical potential difference and it detects It is characterized by having a mode return means to shift to the first mode from the second mode using the information on a drive judging means to judge that said rotor has been driven by a certain driving pulse during a fixed period, and said electrical-potential-difference detection means and said drive judging means.

[0008] Moreover, it is characterized by judging with said drive judging means having been driven when a fixed period drive was carried out by the driving pulse below the driving pulse of predetermined magnitude among two or more driving pulses which said driving pulse creation means creates.

[0009] Moreover, when it judges with said drive judging means having been driven when a fixed period drive was carried out by a certain driving pulse among two or more driving pulses which said driving pulse creation means creates, it is characterized by controlling to change the driving pulse which said driving pulse creation means outputs to a smaller driving pulse.

[0010] Moreover, said first mode is a normal state, said second mode is in an alarm display condition, and the alarm display in this alarm display condition is characterized by being the display by the irregular movement drive of a guide.

[0011]

[Embodiment of the Invention] Hereafter, the example of this invention is explained in full detail based on a drawing. The electronic clock of the example of this invention is a guide-type electronic clock which has the second hand, and has the normal state which is the first mode, and the alarm display condition which is the second mode. Drawing 1 is the block diagram showing the circuitry of the electronic clock of the example of this invention. The solar cell whose 1 is a generation-of-electrical-energy means in drawing, the rechargeable battery whose 2 is an accumulation-of-electricity means, The electrical-potential-difference detector where 3 detects the electrical potential difference of a rechargeable battery 2, the oscillator circuit where 4 used the crystal oscillator, The movement pulse creation circuit which creates various pulses for 5 to drive a frequency divider and for 6 drive a step motor, The alarm display control circuit where 8 usually controls driving pulse output spacing of 1-second movement for a display, and 2-second movement for warning, The step motor with which 12 consists of rotor 12b, stator, and coil 12a,

They are the drive circuit where 9 drives a step motor 12, the rotation detector where 10 detects rotation of rotor 12b, and the drive judging circuit which judges whether 11 has been driven by the driving pulse with same fixed period step motor 12.

[0012] Then, circuit actuation is described. The oscillator circuit 4 is outputting the 32768Hz signal from vibration of a quartz resonator. A frequency divider 5 carries out dividing of this 32768Hz signal, and outputs it to the movement pulse creation circuit 6 and the alarm display control circuit 8. The movement pulse creation circuit 6 creates the usual driving pulses P1-P10 and the amendment driving pulse Pf which are mentioned later, and outputs them to the alarm display control circuit 8. On the other hand, the electrical potential difference of a rechargeable battery 2 detects less than [1.2V] or binary [of whether for it to have reached and to be over 1.3V], and the electrical-potential-difference detector 3 outputs the information to the alarm display control circuit 8.

[0013] In a normal state, the electrical-potential-difference detector 3 judges with the electrical potential difference of a rechargeable battery 2 being over 1.2V, and the alarm display control circuit 8 outputs either of the usual driving pulses P1-P10 which the movement pulse creation circuit 6 creates to the drive circuit 9 at intervals of 1 second. The shape of a pulse form of the usual driving pulses P1-P10 which the movement pulse creation circuit 7 creates here, and the amendment driving pulse Pf is described. Drawing 2 is usually the wave form chart of driving pulses P1-P10 and the amendment driving pulse Pf. (b) is usually a driving pulse P1, and is a usual driving pulse which has the pulse width for 3.25ms. (b) is usually a driving pulse P2, and is a usual driving pulse which has the pulse width for 3.5ms. Moreover, although not illustrated, the usual driving pulse of P3-P8 is a usual driving pulse which has the pulse width for 3.75ms, 4.00ms, 4.25ms, 4.5ms, 4.75ms, and 5.0ms similarly, respectively. Moreover, (Ha), a total of ten kinds of usual driving pulses of the usual driving pulse P9 of the width of face for 5.75ms shown in (d) and the usual driving pulse P10 of the width of face for 5.0ms are prepared. Furthermore, (e) is an amendment driving pulse outputted when it is not able to drive by the above-mentioned driving pulse, is the pulse of the width of face for 16ms usually outputted after [of a driving pulse output time] 30ms, and has 16/32 of the chopper pulse sections in the second half at 8ms. In addition, in electrical-potential-difference 1.3V, when loads, such as a calender, are not applied, it is set up so that a step motor 12 can usually be driven by the driving pulse P6.

[0014] It returns to explanation of circuit actuation again. Usually, driving pulses P1-P10 are amplified in the drive circuit 9, are outputted to coil 12a of a step motor 12, and rotate rotor 12b. The rotation detector 10 judges rotation of rotor 12b, and nonrotation according to the induction current which rotor 12b generates. When judged with nonrotation, the pulse creation circuit 7 is usually changed from a driving pulse Pn to usual driving pulse Pn+1 of driving force big one rank at the time of the output of the following usual driving pulse while it generates the amendment driving pulse Pf immediately and drives rotor 12b certainly. Moreover, when the rotation detector 10 judges with rotation, the pulse creation circuit 7 usually outputs the same usual driving pulse Pn as last time also at the time of the output of the following usual driving pulse. Moreover, the signal of having rotated is sent to the drive judging circuit 11. And when it is able to drive for fixed period T= 256 seconds by the same usual driving pulse Pn, the pulse creation circuit 7 is usually controlled to change to usual driving pulse Pn-1 of driving force small one rank at the time of the output of the following usual driving pulse. The always optimal usual driving pulse can be chosen by performing the above actuation.

[0015] Next, an alarm display condition is described. In the electronic clock of an example, if the electrical potential difference of a rechargeable battery 2 becomes less than [1.2V], it will shift to an alarm display condition. First, the electrical potential difference of a rechargeable battery 2 judges with it being less than [1.2V], and the electrical-potential-difference detector 3 transmits to the alarm display control circuit 8. The alarm display control circuit 8 usually outputs movement spacing of a driving pulse Pn at spacing which is different in every second, and performs the alarm display by movement for 2 seconds. Drawing 3 is the wave form chart showing movement spacing of movement for 2 seconds. If a driving pulse Pn is usually outputted from the end O1 of a coil, as for the other end O2 of a coil, a driving pulse Pn will usually be outputted after [of that]

60ms. A user is told about having performed the alarm display of movement for 2 seconds, and the electrical potential difference having fallen by repeating this every 2 seconds.
[0016] Next, the case where light was equivalent to the solar cell 1, charge was performed to the rechargeable battery 2, and the electrical potential difference of a rechargeable battery 2 rises is described. The electrical-potential-difference detector 3 detects the electrical potential difference of a rechargeable battery 2, and when 1.3V are exceeded, it transmits the information to the alarm display control circuit 8. It controls whether the alarm display control circuit 8 is considered as movement for whether the judgment result of the drive judging circuit 11 is seen further, and movement is continued for 2 seconds as it is, and 1 second. The judgment actuation at this time is explained using a flow chart. Drawing 4 is a flow chart which shows the actuation of which an alarm display is canceled. It begins from the condition of movement for 2 seconds at first, and judges whether in Judgment A, the electrical potential difference of a rechargeable battery 2 is over 1.3V first from the information on the electrical-potential-difference detector 3. If it is not over 1.3V, it progresses to Y, and judges that charge is insufficient, and movement is continued for 2 seconds as it is.
[0017] If the electrical potential difference of a rechargeable battery 2 is over 1.3V, it will progress to N and Judgment B will be performed. That the movement pulse creation circuit 6 is carrying out the current output of the judgment B judges whether whose driving pulse Pn is usually a pulse of the driving force not more than driving pulse P6. Usually, as for the case of the usual driving pulses P7-P10 of the pulse of usually bigger driving force than a driving pulse P6, a driving pulse Pn progresses to N. In this case, although there is a V 1.3 [more than] electrical potential difference of a rechargeable battery 2, since the load of a step motor 12 is heavier than usual, it judges that the further charge is required, and does not cancel an alarm display yet, but continues movement for 2 seconds.
[0018] Usually, when driving pulses Pn are usually the usual driving pulses P1-P6 of the pulse of the driving force not more than driving pulse P6, it progresses to Y. several [next, / to which the drive judging circuit 11 moved the alarm display control circuit 8 by the same usual driving pulse Pn] -- N= 0 is made to reset N It is for avoiding being judged with having been immediately driven by the usual driving pulse Pn same 256 times, after it was set to 1.3V depending on timing, when this did not reset, and counting 256 seconds certainly. And it progresses to Judgment C. Judgment C is a judgment of whether to usually have driven by the driving pulse Pn. When rotation of a step motor 12 was detected in the rotation detector 10, and it did not rotate and is detected, it progresses to "nonrotation", and a driving pulse Pn is usually set to driving pulse Pn+1, and it goes to judge [B] again. Conversely, in rotation detection, it progresses to "rotation", and it increments N to N+1. Furthermore, it progresses to Judgment D and judges whether it is N= 256. If it is not N= 256, Judgment C will be performed again, but if a judgment that it rotated continues and it is set to N= 256, while usually setting a driving pulse Pn to driving pulse Pn-1, an alarm display is canceled and it changes to movement for 1 second.
[0019] The above-mentioned actuation is explained from the relation between voltage variation and the load of a step motor 12. Drawing 5 is the transition diagram of the electrical potential difference of the rechargeable battery 2 of this invention, and the condition of an electronic clock. An axis of ordinate is the electrical potential difference of a rechargeable battery 2, and an axis of abscissa is time amount. It begins and the electrical potential difference of a rechargeable battery 2 has become those or more [1.3] with V, and a normal state. However, if an electrical potential difference falls less than [1.2V] at time of day t11, it will be in an alarm display condition and will become movement for 2 seconds. And an electrical potential difference rises to 1.3V at time of day t12. However, till time of day t14, it is at the time when the load of the SUTTEPU motor 12 is large, and it cannot usually drive by the driving pulse P6 as even if there is a V 1.3 [more than] electrical potential difference, but is usually driving by the driving pulse P8. Therefore, even if fixed period T= 256 seconds pass, it does not change to 1-second movement of a normal state.
[0020] If the load of a step motor 12 becomes small at time of day t14 and an electrical potential difference is again set to 1.3V at time of day t15, a step motor 12 can usually be driven by the driving pulse P6. However, an electrical potential difference becomes less than [1.3V] again

shortly at the time of day t16 when only the time amount T1 which does not reach fixed time amount T passed, and 2-second movement which is an alarm display is not canceled. However, since an electrical potential difference exceeds 1.3V at time of day t17, it can usually drive now by the driving pulse P6 and it usually continued driving by the driving pulse P6 in [fixed period] T= 256 seconds, an alarm display condition is canceled at time of day t18, and it shifts to a normal state.

[0021]

[Effect of the Invention] Since not only the electrical potential difference of a rechargeable battery but the drive situation of the step motor whether a fixed time amount drive was able to be carried out at the usual driving pulse of a certain capacity is taken into consideration by the above explanation so that clearly, and an alarm display condition is canceled, it is possible to cancel an exact alarm display condition. Moreover, in the electronic clock of an example, since the count of the usual driving pulse for discharge of an alarm display condition is used also [thing / for control of a step motor] with the usual electronic clock, there is also an advantage that a component is made few. Furthermore, this invention is applicable not only to discharge of an alarm display but decision of the use propriety of the special function in the electronic clock which has special functions, such as an alarm and a chronograph.

[Brief Description of Drawings]

[Drawing 1] It is the block diagram showing the circuitry of the electronic clock of the example of this invention.

[Drawing 2] Usually, it is the wave form chart of driving pulses P1-P10 and the amendment driving pulse Pf.

[Drawing 3] It is the wave form chart showing movement spacing of movement for 2 seconds.

[Drawing 4] It is the flow chart which shows the actuation of which an alarm display is canceled.

[Drawing 5] It is the transition diagram of the electrical potential difference of the rechargeable battery 2 of this invention, and the condition of an electronic clock.

[Drawing 6] It is the transition diagram of the condition of an electrical potential difference and an electronic clock in the conventional electronic clock.

[Drawing 7] It is the transition diagram of the condition of an electrical potential difference and an electronic clock in the conventional electronic clock.

[Description of Reference Numbers]

1 Solar Cell
2 Rechargeable Battery
3 Electrical-Potential-Difference Detector
6 Movement Pulse Creation Circuit
8 Alarm Display Control Circuit
10 Rotation Detector
11 Drive Judging Circuit
12 Step Motor
P1-P10 It is usually a driving pulse.

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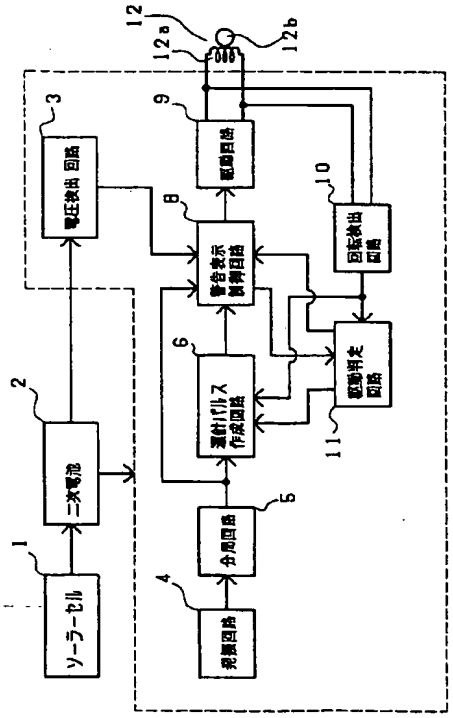
(54)【発明の名称】　電子時計

(57)【要約】

【課題】　蓄電手段の電圧変動によるモードの切り替えを電圧検出だけでなくステップモーターの負荷を考慮することでより最適にモードを切り替えることができる電子時計を提供する。

【解決手段】　蓄電手段の電圧検出手段と、ステップモーターの回転検出手段と、電圧検出手段の検出結果によって第一のモードから第二のモードに移行するモード移行手段とを有する電子時計において、ステップモーターを同一の駆動パルスにて一定期間駆動できたことを判定する駆動判定手段と、前記電圧検出手段と前記駆動判定手段との情報によって第二のモードから第一のモードに移行するモード復帰手段を有する。



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【特許請求の範囲】

【請求項１】　発電手段と該発電手段で発電した電力を蓄える蓄電手段と、該蓄電手段の電圧を検出する電圧検出手段と、ローター、コイル、ステータよりなるステップモーターと、前記ローターの回転、非回転を検出する回転検出手段と、前記ステップモーターを駆動するための複数の駆動パルスを作成する駆動パルス作成手段と、前記電圧検出手段が前記蓄電手段の電圧が所定の電圧よりも低いと検出した場合に第一のモードから第二のモードに移行するモード移行手段とを有する電子時計において、前記ローターを一定期間ある駆動パルスで駆動できたことを判定する駆動判定手段と、前記電圧検出手段と前記駆動判定手段との情報によって第二のモードから第一のモードに移行するモード復帰手段を有することを特徴とする電子時計。

【請求項２】　前記駆動判定手段は前記駆動パルス作成手段の作成する複数の駆動パルスのうち所定の大きさの駆動パルス以下の駆動パルスで一定期間駆動された場合に駆動できたと判定することを特徴とする請求項１記載の電子時計。

【請求項３】　前記駆動判定手段は前記駆動パルス作成手段の作成する複数の駆動パルスのうちある駆動パルスで一定期間駆動された場合に駆動できたと判定した場合に前記駆動パルス作成手段の出力する駆動パルスをより小さな駆動パルスに切り替えるように制御することを特徴とする請求項１または請求項２記載の電子時計。

【請求項４】　前記第一のモードは通常状態であり、前記第二のモードは警告表示状態であり、該警告表示状態における警告表示は指針の変則的な運針駆動による表示であることを特徴とする請求項１乃至請求項３記載の電子時計。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は蓄電手段を有する電子時計の電圧変化でのモード移行に関するものである。

【０００２】

【従来の技術】従来、二次電池等の充放電可能な蓄電手段を有する電子時計の電圧低下の警告表示は一定電圧１．２Ｖ以下になると例えば２秒運針を行うなどといった警告表示をおこなっていた。しかし二次電池に充電が行われ、二次電池の電圧が上昇する場合には１．２Ｖ以上になった場合に直ちに通常運針をさせると直ぐに１．２Ｖ以下になったときまた２秒運針になってしまい、使用上煩わしいという問題がある。よって通常運針になった場合に一定期間通常運針を維持させるために特公平７－４６１５７号や特開平９－９００６４号等の方法が提案されている。

【０００３】特公平７－４６１５７号は電圧によるヒステリシスを持たせる例が紹介されている。この従来の方式による電子時計は二つの検出電圧を有し、二次電池の

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電圧が１．２Ｖ以下になると通常状態から充電を警告する警告表示状態へ移行し、電圧が１．２Ｖより高い電圧である１．３Ｖ以上になると警告表示状態から通常状態に移行する。この場合の例を図面に基づいて説明する。図６は従来の電子時計における電圧と電子時計の状態の遷移図である。縦軸は二次電池の電圧、横軸は時間である。始め二次電池の電圧は１．２Ｖ以上あり、通常状態になっている。しかし時刻ｔ１で電圧が１．２Ｖに下がると警告表示状態となる。そして時刻ｔ２で電圧が１．２Ｖになっても１．３Ｖ以上にならないと通常状態に移行しないためまだ警告表示状態のままである。そして時刻ｔ３でいったん電圧のピークになるが１．３Ｖ以下のため警告表示状態から脱することはできない。更に時間が経過して時刻ｔ４になると電圧が１．３Ｖとなり電子時計は警告表示状態から通常状態に移行する。

【０００４】また特開平９－９００６４号では時間によるヒステリシスを持たせる例が紹介されている。こちらの従来例の電子時計はひとつの検出電圧を有し二次電池の電圧が１．２Ｖを以下になると通常状態から警告表示状態へ移行するが、電圧が１．２Ｖ以上になっても直ちに警告表示状態から通常状態に移行せず一定期間Ｔだけ１．２Ｖ以上であった場合に通常状態に移行する。この場合の例を図面に基づいて説明する。図７はこの電子時計における電圧と電子時計の状態の遷移図である。縦軸は二次電池の電圧、横軸は時間である。始め二次電池の電圧は１．２Ｖ以上あり通常状態になっている。しかし時刻ｔ６で電圧が１．２Ｖに下がると警告表示状態となる。時刻ｔ７で電圧は１．２Ｖになるが一定期間Ｔだけ経過していないためまだ警告表示状態のままである。そして一定期間Ｔより短いＴ１経過した時刻ｔ８で再び電圧が１．２Ｖ以下となってしまい警告表示状態から脱することはできない。そして時刻ｔ９になると再び電圧が１．２Ｖ以上となり時刻ｔ１０まで一定時間Ｔの間１．２Ｖ以上を続けているため電子時計は警告表示状態から通常状態に移行する。

【０００５】

【発明が解決しようとする課題】しかしながら上記の方法では二次電池や電子時計のステップモーターの特性を充分に考慮しているとは言えず問題がある。例えば二次電池は分極作用があるものがあることが知られている。これは急速に充電を行うと二次電池が充分に充電されていないにも関わらず見かけの電圧が上がってしまう現象である。電圧によるヒステリシスではこの見かけの電圧により通常状態に移行してしまい分極作用が収まり電圧が下がった場合に直ぐに警告表示状態になってしまうという問題がある。

【０００６】また電圧のヒステリシスや時間のヒステリシスではともに低温時やカレンダー送り時といったステップモーターの負荷について全く考慮されていない。ステップモーターの負荷が重い場合を考慮して予め通常状

態へ移行する検出電圧を高く設定する必要がある。しかし負荷を考慮して検出電圧を高く設定すると無負荷のときに通常状態に移行しにくくなってしまうという問題が生じる。本発明の目的は上記の問題を解決し、より確実に警告表示状態から通常状態に移行することのできる電子時計を提案する事にある。

【０００７】

【課題を解決するための手段】上記の目的を達成するため本発明は次のような構成をしている。即ち発電手段と該発電手段で発電した電力を蓄える蓄電手段と、該蓄電手段の電圧を検出する電圧検出手段と、ローター、コイル、ステータよりなるステップモーターと、前記ローターの回転、非回転を検出する回転検出手段と、前記ステップモーターを駆動するための複数の駆動パルスを作成する駆動パルス作成手段と、前記電圧検出手段が前記蓄電手段の電圧が所定の電圧よりも低いと検出した場合に第一のモードから第二のモードに移行するモード移行手段とを有する電子時計において、前記ローターを一定期間ある駆動パルスで駆動できたことを判定する駆動判定手段と、前記電圧検出手段と前記駆動判定手段との情報によって第二のモードから第一のモードに移行するモード復帰手段を有することを特徴とする。

【０００８】また前記駆動判定手段は前記駆動パルス作成手段の作成する複数の駆動パルスのうち所定の大きさの駆動パルス以下の駆動パルスで一定期間駆動された場合に駆動できたと判定することを特徴とする。

【０００９】また前記駆動判定手段は前記駆動パルス作成手段の作成する複数の駆動パルスのうちある駆動パルスで一定期間駆動された場合に駆動できたと判定した場合に前記駆動パルス作成手段の出力する駆動パルスをより小さな駆動パルスに切り替えるように制御することを特徴とする。

【００１０】また前記第一のモードは通常状態であり、前記第二のモードは警告表示状態であり、該警告表示状態における警告表示は指針の変則的な運針駆動による表示であることを特徴とする。

【００１１】

【発明の実施の形態】以下、本発明の実施例を図面に基づいて詳述する。本発明の実施例の電子時計は秒針を有する指針式の電子時計であり、第一のモードである通常状態と第二のモードである警告表示状態を有している。図１は本発明の実施例の電子時計の回路構成を示すブロック線図である。図において１は発電手段であるソーラーセル、２は蓄電手段である二次電池、３は二次電池２の電圧を検出する電圧検出回路、４は水晶発振器を用いた発振回路、５は分周回路、６はステップモーターを駆動するための様々なパルスを作成する運針パルス作成回路、８は通常表示のための１秒運針と警告のための２秒運針の駆動パルス出力間隔を制御する警告表示制御回路、１２はローター１２ｂ、ステーター、コイル１２ａよりなるステップモーター、９はステップモーター１２を駆動する駆動回路、１０はローター１２ｂの回転を検出する回転検出回路、１１は一定期間ステップモーター１２が同一の駆動パルスで駆動できたかどうかを判定する駆動判定回路である。

【００１２】続いて回路動作について述べる。発振回路４は水晶振動子の振動より３２７６８Ｈｚの信号を出力している。分周回路５はこの３２７６８Hzの信号を分周して運針パルス作成回路６および警告表示制御回路８に出力する。運針パルス作成回路６は後述する通常駆動パルスＰ１～Ｐ１０及び補正駆動パルスＰｆを作成し警告表示制御回路８に出力する。一方電圧検出回路３は二次電池２の電圧が１．２Ｖ以下か及び１．３Ｖを越えているかの２値を検出しその情報を警告表示制御回路８に出力する。

【００１３】通常状態では電圧検出回路３が二次電池２の電圧が１．２Ｖを越えていると判定し、警告表示制御回路８は運針パルス作成回路６の作成する通常駆動パルスＰ１～Ｐ１０のいずれかを１秒間隔で駆動回路９に出力する。ここで運針パルス作成回路７の作成する通常駆動パルスＰ１～Ｐ１０及び補正駆動パルスＰｆのパルス形状について述べる。図２は通常駆動パルスＰ１～Ｐ１０及び補正駆動パルスＰｆの波形図である。（イ）は通常駆動パルスＰ１であり、３．２５ｍｓのパルス幅を有する通常駆動パルスである。（ロ）は通常駆動パルスＰ２であり、３．５ｍｓのパルス幅を有する通常駆動パルスである。また図示しないが同様にＰ３～Ｐ８の通常駆動パルスはそれぞれ３．７５ｍｓ、４．００ｍｓ、４．２５ｍｓ、４．５ｍｓ、４．７５ｍｓ、５．０ｍｓのパルス幅を有する通常駆動パルスである。また（ハ）、（ニ）に示す５．７５ｍｓの幅の通常駆動パルスＰ９、５．０ｍｓの幅の通常駆動パルスＰ１０の計１０種類の通常駆動パルスが用意されている。更に（ホ）は上記の駆動パルスで駆動できなかったときに出力される補正駆動パルスであり、通常駆動パルス出力時点から３０ｍｓ後に出力される１６ｍｓの幅のパルスであり、後半８ｍｓに１６／３２のチョッパーパルス部を有している。なお電圧１．３Ｖではカレンダー等の負荷が掛かっていない場合は通常駆動パルスＰ６でステップモーター１２を駆動することができるように設定されている。

【００１４】再び回路動作の説明に戻る。通常駆動パルスＰ１～Ｐ１０は駆動回路９で増幅されステップモーター１２のコイル１２ａに出力されローター１２ｂを回転させる。回転検出回路１０はローター１２ｂの発生する誘起電流によってローター１２ｂの回転、非回転を判定する。非回転と判定された場合は通常パルス作成回路７は直ちに補正駆動パルスＰｆを発生しローター１２ｂを確実に駆動すると共に、次の通常駆動パルスの出力時には通常駆動パルスＰｎから１ランク大きな駆動力の通常駆動パルスＰｎ＋１に切り替える。また回転検出回路１

０が回転と判定した場合は通常パルス作成回路７は次の通常駆動パルスの出力時にも前回と同じ通常駆動パルスＰｎを出力する。また回転したという信号は駆動判定回路１１に送られる。そして同一の通常駆動パルスＰｎで一定期間Ｔ＝２５６秒間駆動できた場合は次の通常駆動パルスの出力時に１ランク小さな駆動力の通常駆動パルスＰｎ－１に切り替えるよう通常パルス作成回路７を制御する。以上の動作を行うことによって常に最適な通常駆動パルスを選択することができる。

【００１５】次に警告表示状態について述べる。実施例の電子時計では二次電池２の電圧が１．２Ｖ以下になると警告表示状態に移行する。まず電圧検出回路３が二次電池２の電圧が１．２Ｖ以下であると判定し警告表示制御回路８に伝達する。警告表示制御回路８は通常駆動パルスＰｎの運針間隔を１秒ごととは異なった間隔で出力し２秒運針による警告表示を行う。図３は２秒運針の運針間隔を示す波形図である。コイルの一端Ｏ１から通常駆動パルスＰｎが出力されるとコイルの他端Ｏ２はそれから６０ｍｓ後に通常駆動パルスＰｎが出力される。これを２秒ごとに繰り返すことによって２秒運針の警告表示を行い電圧が下がっていることを使用者に知らせるものである。

【００１６】次にソーラーセル１に光が当たり二次電池２に充電が行われ二次電池２の電圧が上昇していった場合について述べる。電圧検出回路３は二次電池２の電圧を検出し、１．３Ｖを越えた場合はその情報を警告表示制御回路８に伝達する。警告表示制御回路８はさらに駆動判定回路１１の判定結果をみてこのまま２秒運針を続けるか１秒運針とするかの制御を行う。このときの判定動作をフローチャートを用いて説明する。図４は警告表示を解除する動作を示すフローチャートである。最初は２秒運針の状態から始まり、まず判定Ａにおいて二次電池２の電圧が１．３Ｖを越えているかどうかを電圧検出回路３の情報より判定する。１．３Ｖを越えていなければＹに進み充電不足と判断しそのまま２秒運針を続ける。

【００１７】二次電池２の電圧が１．３Ｖを越えていればＮに進み判定Ｂをおこなう。判定Ｂは運針パルス作成回路６の現在出力している通常駆動パルスＰｎが通常駆動パルスＰ６以下の駆動力のパルスであるかどうかを判定する。通常駆動パルスＰｎが通常駆動パルスＰ６より大きな駆動力のパルスの通常駆動パルスＰ７～Ｐ１０の場合はＮに進む。この場合は二次電池２の電圧は１．３Ｖ以上あるがステップモーター１２の負荷が通常よりも重たいため更なる充電が必要と判断してまだ警告表示を解除せず２秒運針を続けるものである。

【００１８】通常駆動パルスＰｎが通常駆動パルスＰ６以下の駆動力のパルスの通常駆動パルスＰ１～Ｐ６であった場合はＹに進む。次に警告表示制御回路８は駆動判定回路１１が同一の通常駆動パルスＰｎで動いた数Ｎを

Ｎ＝０にリセットさせる。これはリセットを行わないとタイミングによっては１．３Ｖになってから直ぐに２５６回同一の通常駆動パルスＰｎで駆動できたと判定されるのを避け、２５６秒を確実にカウントするためである。そして判定Ｃに進む。判定Ｃは通常駆動パルスＰｎで駆動できたかどうかの判定である。ステップモーター１２の回転を回転検出回路１０で検出し、回転しないと検出された場合は「非回転」に進み、通常駆動パルスＰｎを通常駆動パルスＰｎ＋１にして再度判定Ｂに行く。逆に回転検出の場合は「回転」に進みＮをＮ＋１にインクリメントする。更に判定Ｄに進みＮ＝２５６かどうかを判定する。Ｎ＝２５６でなければ再度判定Ｃを行うが、回転したとの判定が続きＮ＝２５６になったら通常駆動パルスＰｎを通常駆動パルスＰｎ－１にすると共に警告表示を解除し１秒運針に切り替える。

【００１９】上記の動作を電圧変動とステップモーター１２の負荷との関係から説明する。図５は本発明の二次電池２の電圧と電子時計の状態の遷移図である。縦軸は二次電池２の電圧、横軸は時間である。始め二次電池２の電圧は１．３Ｖ以上あり、通常状態になっている。しかし時刻ｔ１１で電圧が１．２Ｖ以下に下がると警告表示状態となり２秒運針となる。そして時刻ｔ１２で電圧が１．３Ｖに上昇する。しかし時刻ｔ１４まではスッテプモーター１２の負荷が大きい時であり、電圧が１．３Ｖ以上あってもっても通常駆動パルスＰ６で駆動することができず通常駆動パルスＰ８で駆動されている。よって一定期間Ｔ＝２５６秒が経過しても通常状態の１秒運針には切り替わらない。

【００２０】時刻ｔ１４でステップモーター１２の負荷が小さくなり時刻ｔ１５で再び電圧が１．３Ｖになるとステップモーター１２を通常駆動パルスＰ６で駆動できるようになる。しかし今度は一定時間Ｔに達しない時間Ｔ１だけ経過した時刻ｔ１６で再び電圧が１．３Ｖ以下になり警告表示である２秒運針は解除されない。しかし時刻ｔ１７で電圧が１．３Ｖを越え通常駆動パルスＰ６で駆動できるようになり、一定期間Ｔ＝２５６秒の間で通常駆動パルスＰ６で駆動し続けたので時刻ｔ１８で警告表示状態を解除し通常状態に移行する。

【００２１】

【発明の効果】以上の説明で明らかなように二次電池の電圧だけでなくある能力の通常駆動パルスで一定時間駆動できたかというステップモーターの駆動状況も考慮して警告表示状態の解除を行うためより的確な警告表示状態の解除を行うことが可能である。また実施例の電子時計では警告表示状態の解除のための通常駆動パルスのカウントを通常の電子時計でステップモーターの制御用のものと兼用しているため構成要素が少なくできるという利点もある。さらに本発明は警告表示の解除だけでなくアラームやクロノグラフといった特殊機能を有する電子時計での特殊機能の使用可否の判断にも使用できるもの

である。

【図面の簡単な説明】

【図１】本発明の実施例の電子時計の回路構成を示すブロック線図である。

【図２】通常駆動パルスＰ１～Ｐ１０及び補正駆動パルスＰｆの波形図である。

【図３】２秒運針の運針間隔を示す波形図である。

【図４】警告表示を解除する動作を示すフローチャートである。

【図５】本発明の二次電池２の電圧と電子時計の状態の遷移図である。

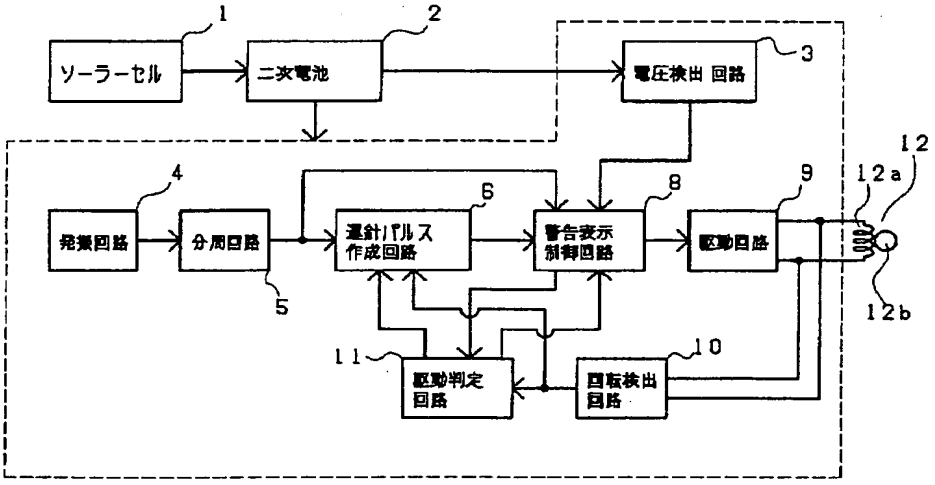
【図６】従来の電子時計における電圧と電子時計の状態の遷移図である。

【図７】従来の電子時計における電圧と電子時計の状態の遷移図である。

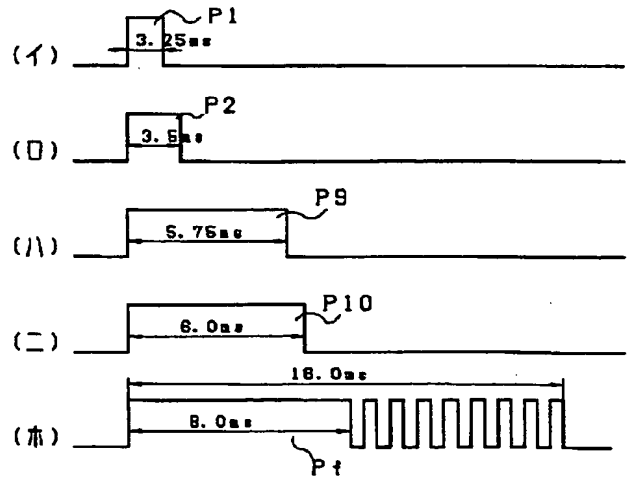
【符号の説明】

１　ソーラーセル
２　二次電池
３　電圧検出回路
６　運針パルス作成回路
８　警告表示制御回路
１０　回転検出回路
１１　駆動判定回路
１２　ステップモーター
Ｐ１～Ｐ１０　通常駆動パルス

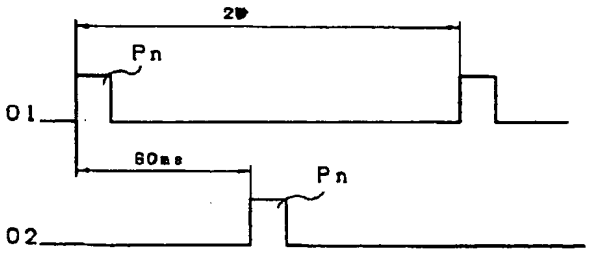
【図１】



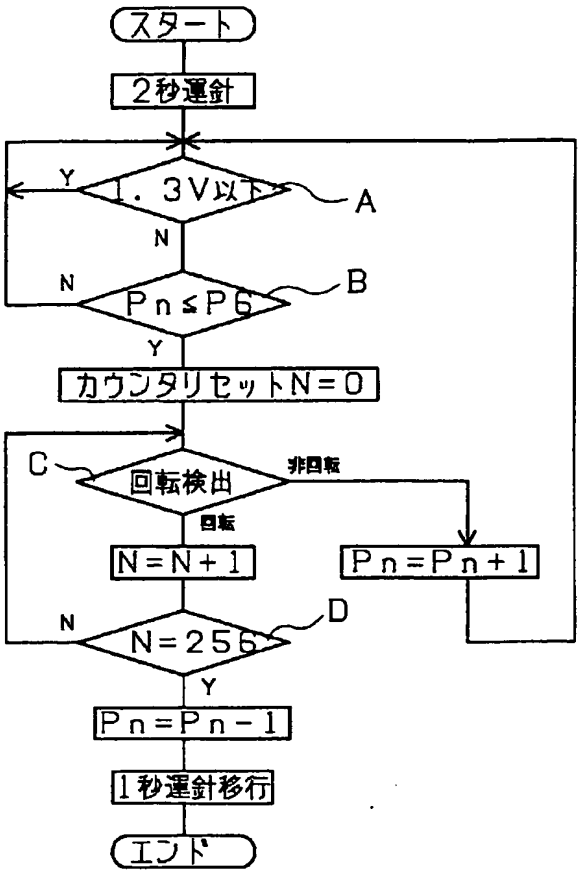
【図２】



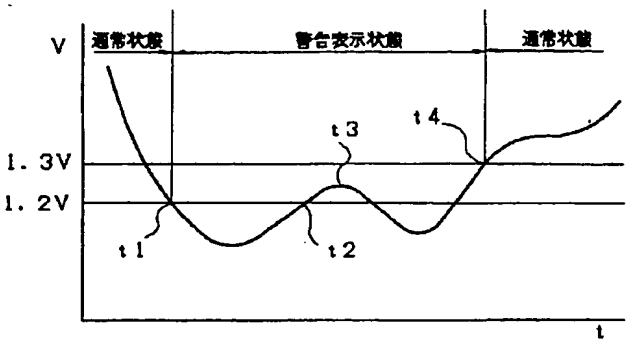
【図３】



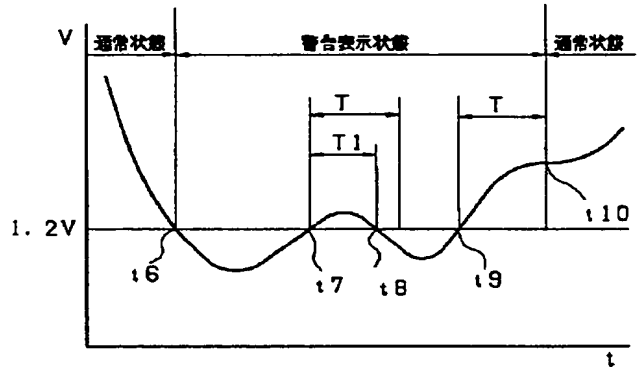
【図４】


スタート
2秒運針
Y
1．3V以下
A
N
N
Pn≦P6
B
Y
カウンタリセットN=0
C
回転検出
非回転
回転
N=N+1
Pn=Pn+1
N
N=256
D
Y
Pn=Pn-1
1秒運針移行
エンド

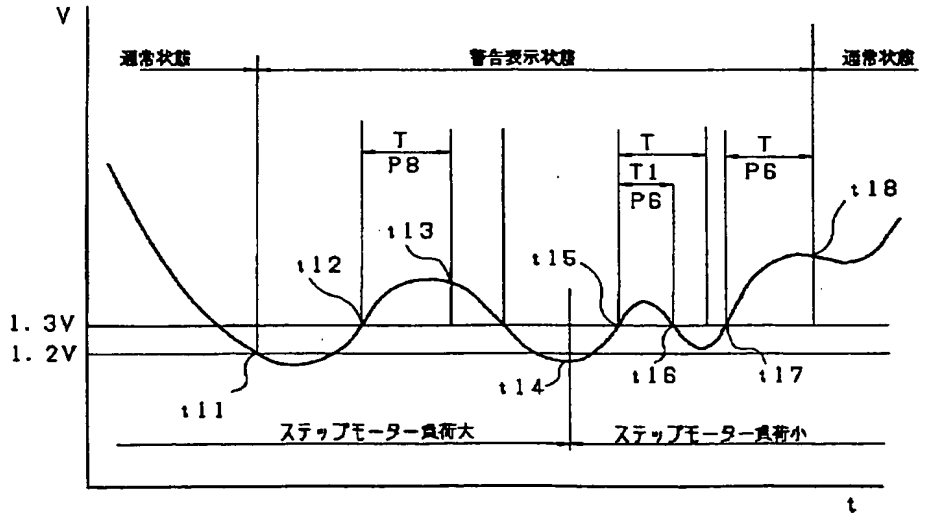
【図６】


V
通常状態
警告表示状態
通常状態
1．3V
1．2V
t1
t2
t3
t4
t

【図７】


V
通常状態
警告表示状態
通常状態
T
T1
T
1．2V
t6
t7
t8
t9
t10
t

【図５】


V
通常状態
警告表示状態
通常状態
T
P8
T
T1
P6
T
P6
t12
t13
t15
t18
1．3V
1．2V
t11
t14
t16
t17
ステップモーター負荷大
ステップモーター負荷小
t